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A TAXONOMIST'S GENETIC PREDICTION COMES TRUE

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ABSTRACT

Based on *Drosera* scheme of pairing (x II+x I) in 6x F_1 hybrid between 8x *Celosia argentea* and 4x *C. cristata*, it was concluded by geneticists that the latter is one of the parents of the former. This view was rejected by horticulturists and taxonomists, particularly van Steenis, on the grounds that a species like *C. cristata* (cockscomb), which has arisen and is existing only in cultivation, cannot be the parent of a very old and widespread wild taxon, like 8x *C. argentea* especially because of the grotesque morphology of the cultivated taxon. He predicted that more search may reveal a taxon within *C. argentea* complex that may fill this gap and which may be the actual ancestor of cultivated *C. cristata*. With the discovery in Central India of a wild 4x form of *C. argentea* (showing potentialities for fasciation) van Steenis' prediction has come out true, because this taxon is genetically perfectly compatible with the tetraploid cultivated *C. cristata*.

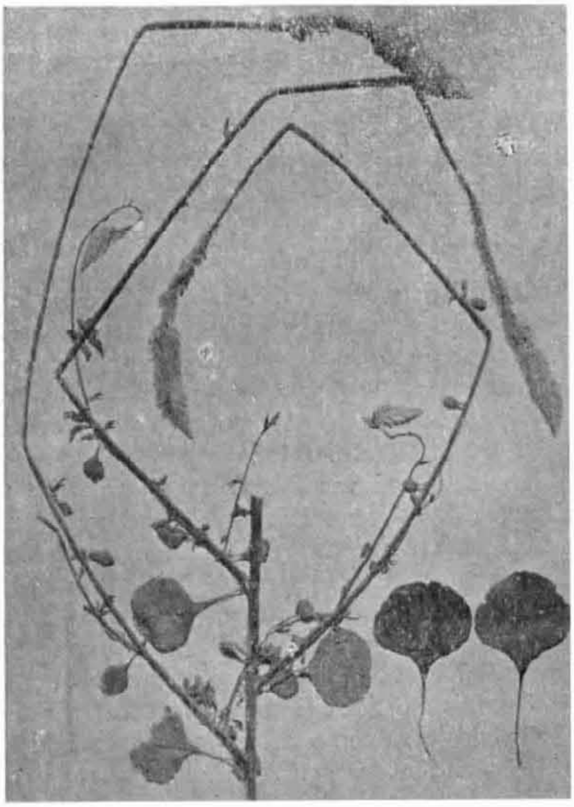
INTRODUCTION

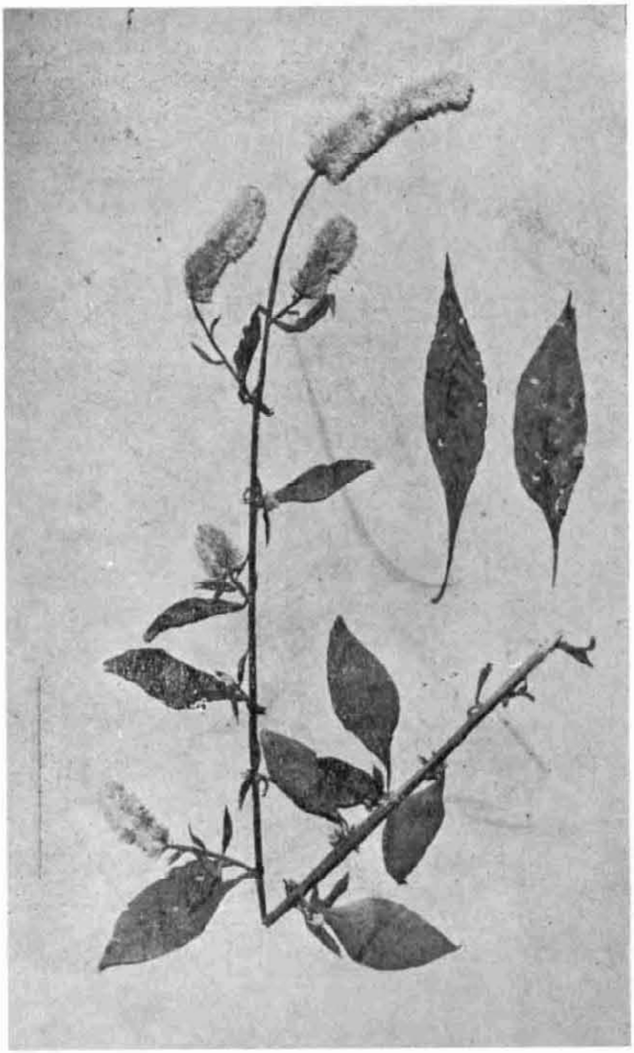
More often traditional taxonomy and taxonomic implications of genetical analyses end up in similar if not identical, taxonomic treatments (*Rollins,* 1952 ; *Khoshoo,* 1958, 1967) because most taxonomists in a herbarium, after seeing the pattern of phenotypic variation throughout the range of a species, produce a taxonomic system which subsequent genetic analysis often shows is phylogenetic as well. However, there are occasions when the two approaches are apparently at cross purposes. During our applied-basic studies on some ornamental and medicinal plants, we have come across one such example, where the taxonomist concerned (*van Steenis,* 1958) though unable to brush aside the then available genetic data, made a prediction, based according to him, on 'commonsense'. This has come true.

The common cockscomb, *Celosia cristata* Linn. [*C. argentea* Linn. var. *cristata* (Linn.) Kuntze], is the only cultivated species in the genus. The other equally well known species is *C. argentea* Linn., a pantropical troublesome weed. Wakakuwa (1931) and particularly Grant (1954) have shown the former to be uniformly tetraploid (2n=36), and the latter an octoploid (2n=72). Furthermore, they found 18 II + 18 I in the hexaploid interspecific hybrid, from which they concluded that cockscomb (*C. cristata*), a cultivated species, is one of the parents of the octoploid weedy species (*C. argentea*). This is, however, contrary to the conclusions of all taxonomists and also the widely held opinion of all horticulturists that the weedy *C. argentea* (8x) represents morphologically the ancestral condition from which has arisen the cultivated ornamental 4x *C. cristata* (*Schinz,* 1893, 1934 ; *Hooker,* 1885, *Kuntze,* 1891 ; *Standley* and *Steyermark,* 1946 ; *Bailey,* 1909, 1928 ; *White,* 1948 ; *Backer,* 1949 ; *van Steenis,* 1956 ; *Li,* 1959 ; *Haines,* 1961 ; *Aellen,* 1961 ; *Duke,* 1961 ; *Cavaco,* 1962 ; etc.). The above conclusions provoked van Steenis (1958) to write that "this would represent, I feel, genetically a most unusual situation as it implies that cockscomb would have been the ancestral species. It is known only in cultivation..." Furthermore, he predicted that "I expect that further chromosome counting must reveal diploid *C. argentea,* my commonsense tells me that this must be the ancestral plant from which a polyploid cockscomb arose as a sport and was saved by ancient man as a curiosity".

The investigation of the present writers on the wild and cultivated celosias of India (unpublished work) has shown that van Steenis' prediction has come true and a wild tetraploid form of *C. argentea* has been discovered in Central India (Madhya Pradesh). This discovery assumed importance because India is regarded by some as the centre of origin of *C. cristata* (*Grant,* 1954, 1962a) and King found "traces of a very old cultivation of cockscomb in Rajmahal Hills" (*Hooker,* 1885).

The tetraploid form of *C. argentea* is distinguishable by its broader than long leaves with an abruptly pointed apex in contrast to the ovato-lanceolate leaves in the more common octoploid *C. argentea* (Plates 1-2). Moreover, at maturity while the tip of inflorescence in the former is pointed and rather drawnout, it is relatively blunt in the latter. This is due to the fact that growing points of infloresccences continue to grow and keep on producing flowers in the tetraploid, while they stop growth in the octoploid race. An examination of the herbarium material in the Royal Botanic Gardens, Kew and Edinburgh by one of us (T.N.K.) has shown that the tetraploid taxon is confined only to Central India, Bombay and Madras.





Plates 1-2. Herbarium specimens of 4x and 8x forms of *C. argentea*. Note the difference in the leaf shape.

The genetical experiments (Fig. 1) of the present writers extending from F_1 to F_5 have shown 4x *C. argentea* to be perfectly genetically compatible (ecospecific differentiation) with cultivated *C. cristata*. Further, like the latter it also forms a 6x hybrid with 18 II+18 I with 8x *C. argentea*. Again, parallel to the origin of 12-ploid *C. whiteii* from the 6x hybrid (8x *C. argentea* × 4x *C. cristata*) which was obtained by Grant (1961, 1962 a b), the present writers have also recovered from the progeny of 6x hybrid (8x *C. argentea* × 4x *C. argentea*) a remarkably vigorous 12x amphiploid with perfect preferential pairing and normal fertility (Fig. 1).

It thus appears that the tetraploid form of *C. argentea* discovered by the writers may have been the probable wild ancestor from which tetraploid *C. cristata* has arisen in cultivation. Unlike the 8x *C. argentea*, its 4x form has shown strong tendencies for fasciation and continued growth of the growing point of inflorescences which facts again bring 4x *C. argentea* nearer to 4x *C. cristata*. Such an interpretation fits very well with what van Steenis (1958) predicted purely on taxonomic grounds. Further, the identical pairing behaviour of 4x *C. argentea* and 4x *C. cristata* in hybrids with 8x *C. argentea* makes the view that 4x *C. cristata* (arising and exist-

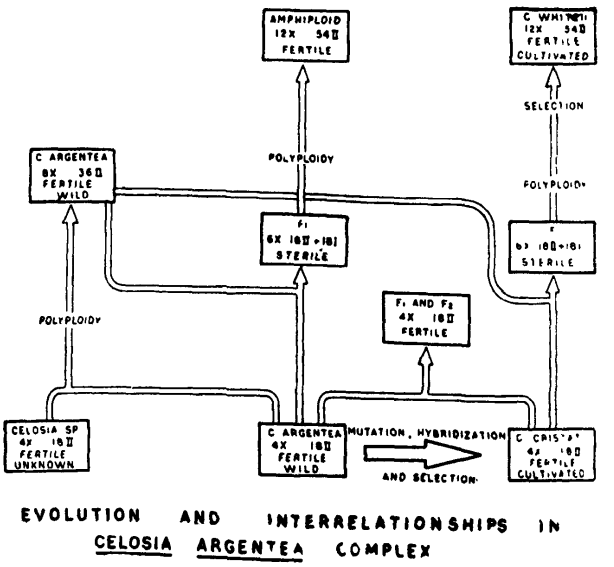


Fig. 1. Genetic interrelationships within *C. argentea* complex

ing only in cultivation) has been one of the probable parents of the wild and widespread weedy 8x *C. argentea* untenable.

It is the belief of the present writers that if traditional taxonomic criteria are applied after a careful and broad-based study of herbarium material, there is likely to ensue a sound taxonomic classification. Furthermore, the *Drosera* scheme (x II+x I) of pairing relationships in F_1 hybrid may not be enough for drawing conclusions with regard to parentage, because it is now well known that such pairing in F_1 hybrids can itself be under genetic control. Therefore, an uncritical use of genetic criterion, disregarding morphology altogether, as had happened in the present case, can lead to erroneous conclusions.

REFERENCES

Aellen, P. *Die Amaranthaceen Mitteleuropas.* Carl. Hanser Verlag, Munchen, 1961.

Backer, C. A. *Celosia. Flora Malesiana* Ser. I, 4 : 73-74, 1949.

Bailey, L. H. *Cyclopaedia of American Horticulture.* The MacMillan Company, New York, 1909.

—— *The standard cyclopaedia of Horticulture.* The MacMillan Company, New York, 1928.

Cavaco, A. Les Amaranthaceae de l' afrique au sud du Tropique du Cancer et de Madagascar. *Mem. Mus. Hist. Nat.* (Paris), Series B (Botany) 13 : 1-254, 1962.

Duke, J. A. Chenopodiaceae, Amaranthaceae, Caryophyllaceae (In Flora of Panama, Part IV. Fascicle 4). *Ann. Miss. Bot. Gard.*, 4 : 1-106 (343-448), 1961.

Grant, W. F. A cytological study of *Celosia argentea, C. argentea* var. *cristata* and their hybrids. *Bot. Gaz.*, 115: 323-336, 1954.

—— Speciation and nomenclature in the genus *Celosia. Canad. J. Bot.* 40 : 1355-1363, 1962 a.

—— Malayan Fantasy—A new garden cockscomb. *Amer. Hort. Mag.* 41 : 201-204, 1962b.

Haines, H. H. *Botany of Bihar and Orissa,* Vol. II. (Reprinted Edition) Calcutta, 1961.

Hooker, J. D. *The Flora of British India,* Vol. IV. Reeves and Co. Ltd., Kent, England, 1885.

Khoshoo, T. N. *Cytological investigations on some conifers and natural polyploids of some angiosperms.* Doctoral Thesis, Panjab University, India, pp. 190-208, 1958.

—— Biosystematics of *Sisymbrium irio* complex XIII. Taxonomic considerations. *Bull. bot. Surv. India.* 9 : 49-55, 1967.

Kuntze, O. *Revisio Generum Plantarum,* pp. 541, 1891.

Li, H. L. The garden flowers of China. *International Biological and Agricultural series.* No. 19. Rowal Press Co. New York, 1959.

Rollins, R. C. Taxonomy today and tomorrow. *Rhodora* 54 : 1-19, 1952.

Schinz, H. *Celosia.* In *Die naturlichen Pflanzenfamilien.* A. Engler and K. Prantl. 3 : 99-100, 1893.

—— Amaranthaceae. *In Die naturlichen Pflanzenfamilien.* A. Engler and K. Prantl. 16C : 7-85, 1934.

Standley, P. C. Amaranthaceae. *North American Flora* 21: 95-169, 1917.

—— and J. A. Steyermark. *Celosia.* In *Flora of Guatemala,* Fieldiana, Bot. 24 : 158, 1946.

van Steenis, C. G. G. J. Bibliography. *Flora Malesiana.* Bull. 12 : 518, 1956.

—— Amaranthaceae. In Addenda Corrigenda et emendanda, *Flora Malesiana* 5 : 554, 1958.

Wakakuwa, S. H. A karyological study on the triploid hybrid of the genus *Celosia. Jap. J. Genet.* 7 :17-23, 1931.

White, O. E. Fasciation. *Bot. Rev.*, 14 : 319-358, 1948.